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(54) Particle collection systems

(57) A particle collection system comprises a series of parallel troughs 11, 12 in a blast room floor for receiving particles therein. Collection ducts 15, 16 receive particles from the troughs 11, 12, and air flow inducers 19, 20 connected to the collection ducts 15, 16 induce relatively large volume carrier air flows at relatively low pressure in the collection ducts 15, 16 in response to relatively small volume control air flows at relatively high pressure to draw particles along the collection ducts into common recovery conduit 31 along which the particles are conducted towards a particle collection zone. The air requirement of such a system is relatively low, and thus the capacity of associated air components, such as a fan or cyclone, may be lower than would otherwise be required, so that the system as a whole is economical both to install and to run.

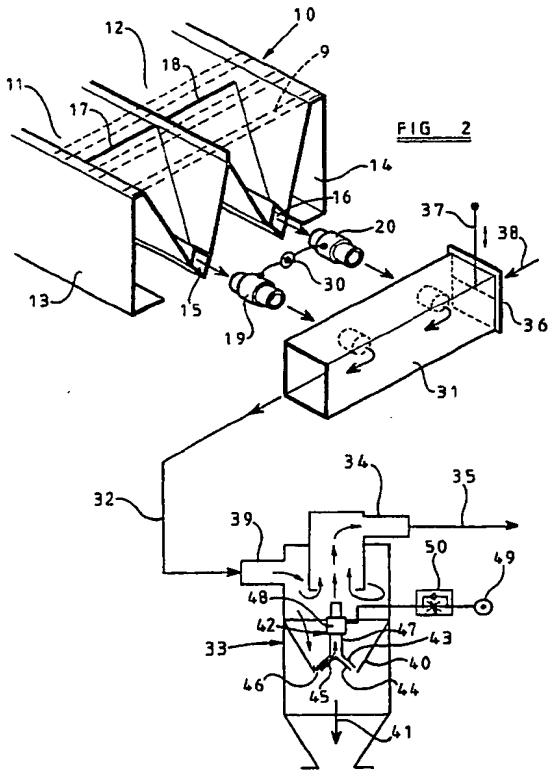

FIG 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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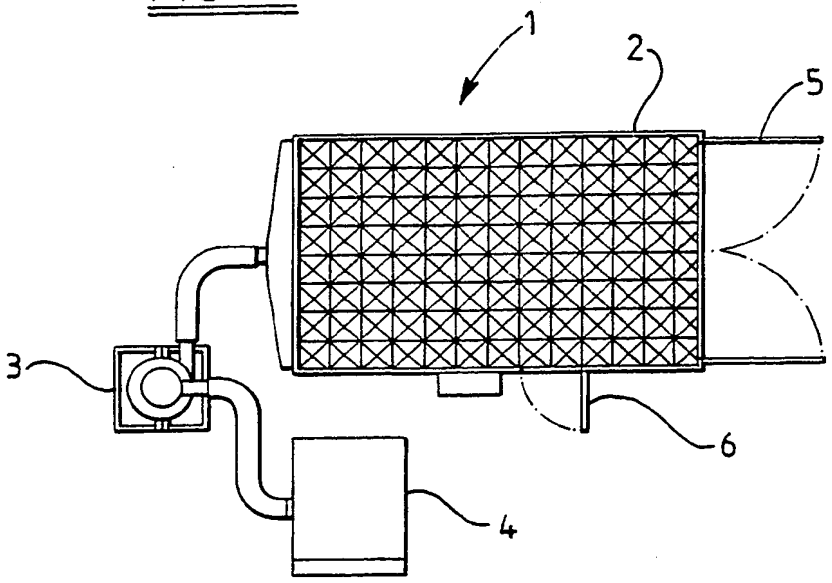
FIG 1



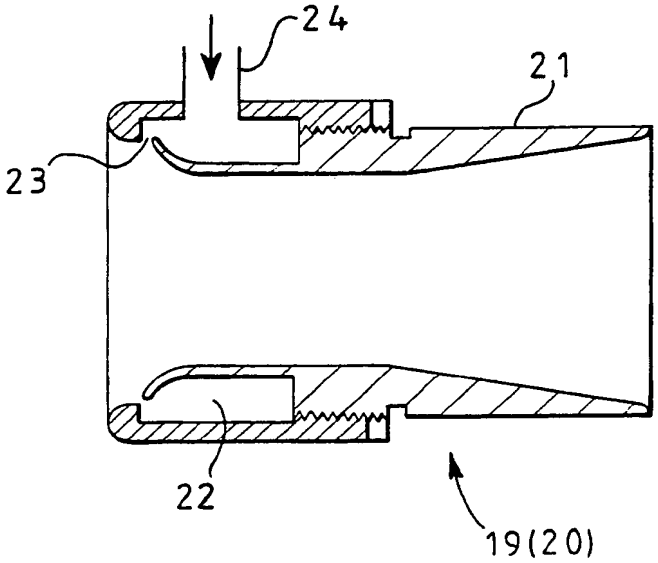


FIG 3

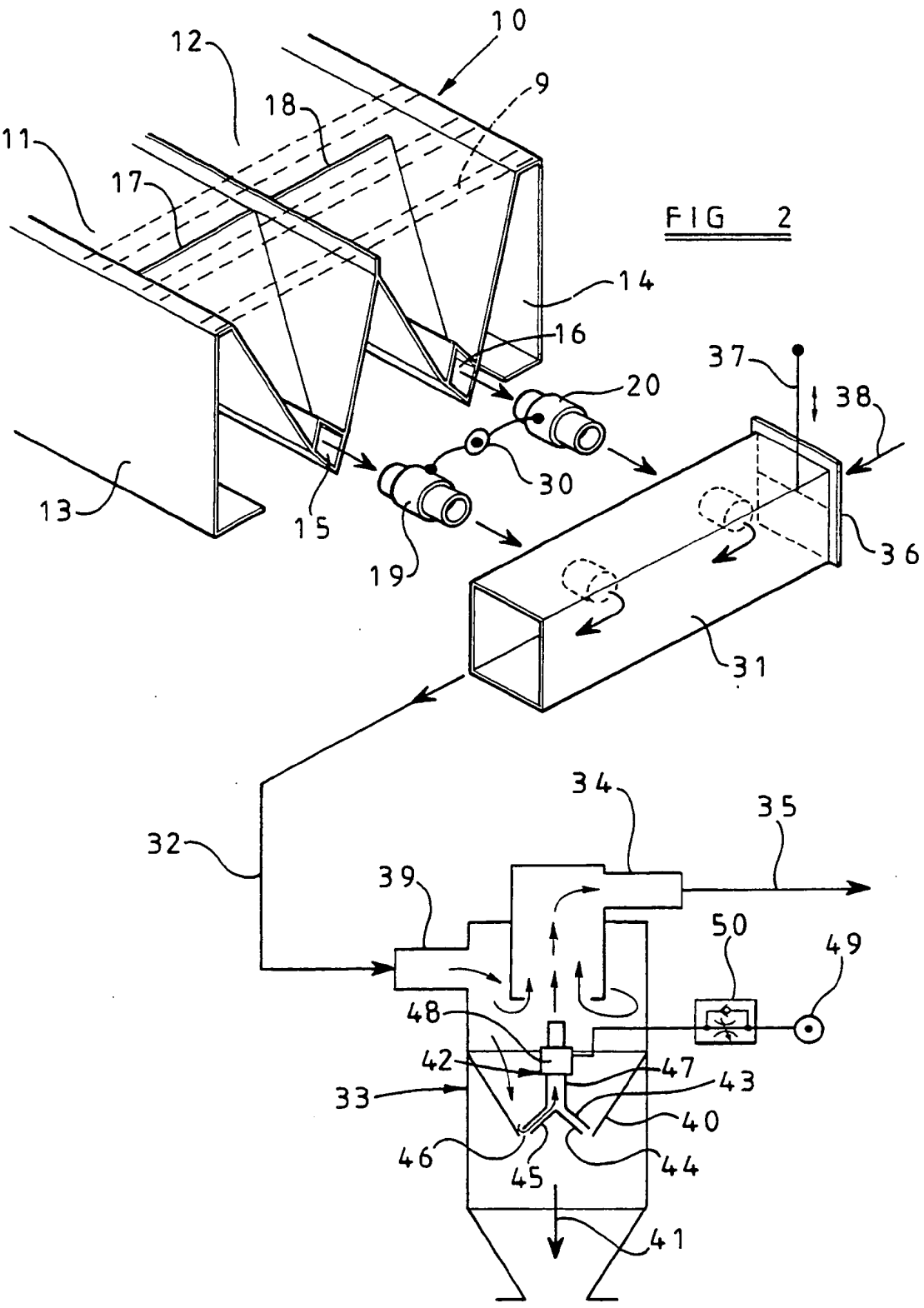
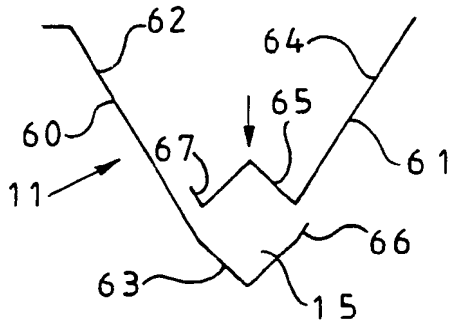


FIG 2

FIG 4



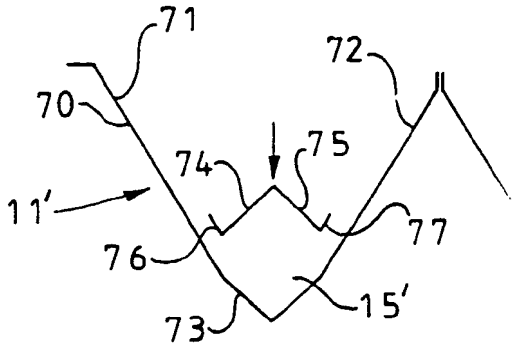
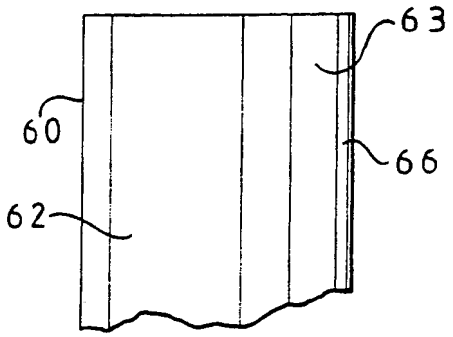


FIG 7

FIG 5



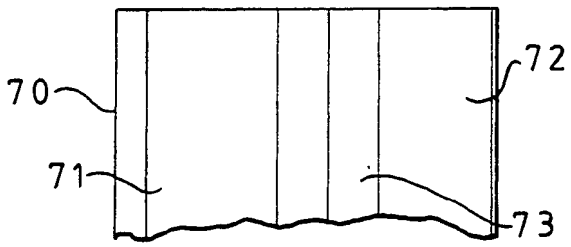
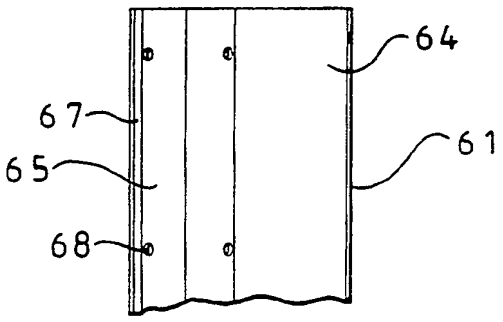


FIG 8

FIG 6



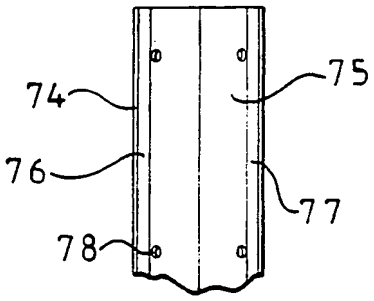


FIG 9

"Particle Collection Systems"

This invention relates to particle collection systems, and is concerned more particularly, but not exclusively, with such systems for the collection and recycling of the particles used in a peening or coating removal process in which a surface to be treated is impacted by such particles.

It is known to remove a coating, such as a layer of paint, from a surface to be treated by blasting the surface with a stream of metal or plastics particles fired from a particle gun. Paint removal by use of such a surface blasting process is particularly advantageous in certain fields as it eliminates the need to use hazardous paint-removing solvents and is capable of removing paint layers with particular accuracy so that, for example, it is often possible to use such a process to remove an outer paint layer whilst leaving an inner paint layer intact. A similar surface blasting process can be used to counteract the effects of the stress induced in a machined surface by the machining of such a surface. Such a process, which is commonly referred to as peening, is highly effective in increasing the service life of machined parts which are subjected to high stress in use, such as certain aircraft parts.

In order to contain both the particles used in such a surface blasting treatment process and the material removed from the surface, it is usual to provide a specially adapted blast room within which the object to be treated is accommodated. Such a blast room will generally include a

floor incorporating particle collection ducts into which pass the particles which have been used in, and the material which has been removed by, the blasting process and along which the particles and entrained material are conducted by an air flow towards a cyclone which separates the particles from the air flow and also from the entrained material and returns the particles to a particle collection zone to permit them to be used again in the surface blasting process. The air flow which is used to conduct the particles through the particle collection system is induced by a fan, and the size of the fan, as well as the size of the cyclone used to subsequently separate the particles from the air flow, is dependent on the size of the particle collection area provided in the floor of the blast room. Thus, where a blast room having a large particle collection area is required for the treatment of large objects, a large fan and a large cyclone are required, and these significantly increase both the installation costs and the running costs of the blast room.

It is an object of the invention to provide a particle collection system which has a lower air requirement than prior systems of comparable capacity, and which can accordingly be used with a smaller fan and/or smaller cyclone than such prior systems.

According to the present invention there is provided a particle collection system comprising trough means for receiving particles therein, collection duct means associated with the trough means for receiving particles from the trough means, air flow induction means for inducing a relatively

large volume carrier air flow at relatively low pressure in the collection duct means in response to a relatively small volume control air flow at relatively high pressure in order to draw particles along the collection duct means in the carrier air flow, and air conduit means into which the particles are drawn in the carrier air flow from the collection duct means and along which the particles are conducted towards a particle collection zone.

Such a particle collection system is particularly advantageous when used for recycling of particles used in a surface blasting process as referred to above, in which case the trough means will generally be incorporated in the floor of a specially adapted blast room. In this case the particles which are received by the trough means will include both the particles used for blasting and also entrained material which has been removed by the blasting process. Because only a relatively small volume control air flow is required to induce the carrier air flow for conducting the particles along the collection duct means, the air requirement of such a system is relatively low, and thus the capacity of associated air components, such as a fan or cyclone, may be lower than would otherwise be required, so that the system as a whole is economical both to install and to run. Furthermore the control air flow may be adjustable to suite the particular requirements in use of the system.

However it should be appreciated that the particle collection system is not limited to use in a surface blasting process. In fact the system may be used in any application

in which the collection and transport of particulate material is desired.

In a preferred embodiment the trough means comprises a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles towards the bottoms of the troughs, and the collection duct means comprises a series of collection ducts each of which is provided at the bottom of a respective one of the troughs. The troughs preferably include transverse dividers spaced at intervals along their lengths.

Preferably the air flow induction means comprises a respective air flow inducer coupled to each collection duct so as to draw particles along the collection duct towards the air conduit means in a carrier air flow induced by a control air flow applied to the air flow inducer.

Furthermore it is preferred that an air controller is coupled to the air flow induction means so as to apply pulsed control air flows to the air flow inducers in a predetermined sequence so as to induce pulsed carrier air flows in the collection ducts.

In one embodiment of the invention the air flow induction means comprises a plurality of pairs of air flow inducers, and the air controller is arranged to apply a respective pulsed control air flow to each pair of air flow inducers separately from each of the other pairs of air flow inducers and to apply such control air flows to the pairs of air flow inducers consecutively.

Conveniently the air conduit means comprises a

common air conduit along which a continuous flow of air is conducted and into which the particles are drawn from the collection duct means by a series of carrier air flows.

The air conduit means may be coupled to cyclone means for separating the particles from the continuous flow of air and for supplying the separated particles to the particle collection zone.

Furthermore the air conduit means may be coupled to a fan for drawing said continuous flow of air therethrough and may be provided with a damper for controlling the input of air drawn into the air conduit means by the fan.

The invention also provides a particle cleaning system comprising cyclone means for receiving an air flow containing particles and entrained material and incorporating outlet means through which particles and entrained material separated from the air flow by the cyclone means pass towards a particle collector, extraction means defining a gap through which the separated particles and entrained material are conducted as they pass through the outlet means and incorporating an extraction duct opening into the gap, and air flow induction means for inducing a relatively large volume carrier air flow at a relatively low pressure in the extraction duct in response to a relatively small volume control air flow at a relatively high pressure in order to draw entrained material away from the particles conducted through the gap and carry the entrained material in the induced carrier air flow along the extraction duct towards an entrained material extraction zone.

Such a particle cleaning system can be made to be adjustable by variation of the air control flow in order to permit the carrier air flow to be finely set to ensure that the entrained material is removed from the particles in an efficient manner without drawing the particles themselves along the extraction duct.

The invention further provides a particle collection system comprising a floor incorporating a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles which land on the floor towards the bottoms of the troughs, and a series of collection ducts each of which is provided at the bottom of a respective one of the troughs and has a lower wall which is integrally formed with at least one of the side walls of the trough and an upper wall which is joined to the lower wall along its longitudinal edges, holes being provided at intervals along the length of the upper wall for passage of particles into the duct.

In order that the invention may be more fully understood, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a schematic plan view of a blast room;

Figure 2 is a schematic diagram showing parts of a particle collection system in accordance with the invention, partly in perspective view and partly in axial section;

Figure 3 is an explanatory diagram showing an air flow inducer in axial section;

Figures 4 to 6 show various views of part of a

particle collection floor in accordance with the invention; and

Figures 7, 8 and 9 show various views of part of an alternative particle collection floor in accordance with the invention.

Figure 1 shows a blast room 1 which is adapted to contain an object to be treated by subjecting it to impact by a stream of particles fired from a particle gun held by an operator within the room. The room 1 has a floor 2 of waffle construction which is specially adapted for collection of particles fired from the gun after they have rebounded from the object and, in many cases, also from the walls of the room, and which is connected to a cyclone 3 and a dust collector 4. The blast room 1 is also provided with end doors 5 for introduction of the object to be treated, and a further door 6 for operator access. As will be described in more detail below, the room is provided with a particle collection system which collects the particles and the material removed by the particles, separates the particles from the other material and returns the particles to a particle collection zone so that the particles can be reused in the blasting process.

Figure 2 shows a portion 10 of the blast room floor which comprises a pair of parallel troughs 11 and 12 supported by two channel-section support members 13 and 14, which also support an overlying floor grid 9 (shown in broken lines), and having at their bottoms two collection ducts 15 and 16. Each trough 11 or 12 also has spaced along its length a series of

transverse dividers 17 or 18 each of which has two oppositely inclined walls which, together with the oppositely inclined walls of the associated trough 11 or 12, serve to channel the particles towards apertures (not shown in Figure 2) in the upper wall of the collection duct 15 or 16 so that the particles pass into the interior of the duct. In a typical blast room floor a series of such portions 10 will be arranged side-by-side so as to impart to the floor the waffle construction already referred to.

Furthermore, as shown schematically in Figure 2, respective air flow inducers 19 and 20 are connected to the outlets of the connection ducts 15 and 16. As may be appreciated more particularly by referring to Figure 3, each air flow inducer 19 or 20, which is of per se known type, comprises a main air flow conduit 21 surrounded by an annular chamber 22 which opens into the duct 21 by way of a narrow annular gap 23 so that the application of a control flow of compressed air of relatively small volume but having a relatively high pressure by way of a control duct 24 provides a flow of air through the gap 23 which induces a relatively large volume carrier air flow at a relatively low pressure in the duct 21. In this way a small volume compressed air flow may be used to induce air flows, drawn into the collection ducts 15 and 16 through their opposite, open ends, for transporting the particles without it being necessary to provide high volume air flows along the ducts produced by a fan for this purpose.

In the particular embodiment of Figure 2, the air

flow inducers 19 and 20 are supplied with a pulse of compressed air by way of a common control duct 30 so as to produce pulsed carrier air flows in the collection ducts 15 and 16 for carrying the particles and entrained material along the ducts 15 and 16 and through the air flow inducers 19 and 20 into a common recovery conduit 31 to which the outlets of the air flow inducers 19 and 20 are connected. The pulsed control air flow is supplied from a source of compressed air by way of a process sequencer (not shown) which supplies a pulse of air to each pair of air flow inducers 19, 20 in turn. Various modes of sequencing the pairs of air flow inducers are possible, and it may be desirable to apply a greater number of control air pulses, or control air pulses of greater length, to those pairs of air flow inducers which are associated with the parts of the floor which will tend to receive the greater number of particles, that is the parts of the floor closest to the side walls of the blast room.

As shown schematically by the arrow 32 in Figure 2, the recovery conduit 31 is coupled by a flexible hose to a cyclone 33 which in turn has an air outlet 34 coupled to a centrifugal fan, as indicated schematically by the arrow 35. Furthermore the recovery conduit 31 has an inlet 36 provided with a damper 37 which may be adjusted to vary the quantity of air drawn through the inlet 36 in the direction of the arrow 38. It will be appreciated that the fan will produce a continuous flow of air drawn through the inlet 36 into the recovery conduit 31, and that this flow of air will conduct the particles and entrained material injected into the

recovery conduit 31 by way of the air flow inducers 19, 20 so as to carry the particles and entrained material into the inlet 39 of the cyclone 33 for the purpose of separating the particles from the entrained material and the air flow. The fact the particles are transported into the recovery conduit 31 by pulsed carrier air flows, rather than continuous carrier air flows, is advantageous not only because it decreases the total quantity of air required for the control air flows which induce the carrier air flows, but also because it minimises the total quantity of air which is conducted along the recovery conduit 31 and thus enables the size of the cyclone 33 to be kept to a minimum.

As is well known, the cyclone 33 imparts a vortex motion to the incoming air flow in order to cause the entrained particles to be forced outwardly by centrifugal action and to enter an outlet funnel 40 through which the particles fall under gravity in the direction of the arrow 41 towards a particle collector (not shown). The air flow from which the particles have been separated rises in a vortex towards the outlet 34.

Furthermore, in order to separate the entrained material from the particles prior to the particles being supplied to the particle collector, an extractor 42 is positioned within the funnel 40 and includes upper and lower conical members 43 and 44 which define therebetween a narrow inlet 45 of an extraction duct 47, the inlet 45 opening radially outwardly into an annular gap 46 between the outer peripheries of the conical members 43 and 44 and the inside

wall of the funnel 40. The extraction duct 47 is provided with an air flow inducer 48 which is supplied with compressed air from a compressed air duct 49 in order to induce a relatively large volume carrier air flow at relatively low pressure in the extraction duct 47. This creates a flow of air into the inlet 45 in the vicinity of the annular gap 46 which draws entrained material from the particles passing through the gap 46 and carries such material in the induced carrier air flow along the extraction duct 47 towards the air outlet 34 and eventually to an extractor (not shown) upstream of the fan. A needle valve 50 permits adjustment of the control air flow applied to the air flow inducer 48 so as to finely adjust the carrier air flow along the extraction duct 47 so as to ensure optimum cleaning of the particles by removal of the entrained material without drawing the particles themselves along the extraction duct 47.

Figure 4 is a cross sectional view of the trough 11 showing how this may be formed by welding two appropriately profiled metal sheets 60 and 61. Figure 5 shows a plan view of one end of the sheet 60, and Figure 6 shows a plan view of one end of the sheet 61. The sheet 60 forms both an inclined side wall 62 of the trough 11 and a lower wall 63 of the associated collection duct 15, whereas the sheet 61 forms both the other inclined side wall 64 of the trough 11 and an upper wall 65 of the collection duct 15. Furthermore the sheets 60 and 61 are formed with flanges 66 and 67 by means of which the lower and upper walls 63 and 65 are joined along their longitudinal edges by means of adhesive tape or by some other

suitable bonding means, such as a weld. As may be seen in Figure 6, holes 68 are formed in the upper wall 65 by drilling for the passage of particles into the duct 15.

Figure 7 shows an alternative form of trough 11' incorporating a collection duct 15' at its bottom. In this case a single profiled sheet 70 forms both of the inclined side walls 71 and 72 of the trough, as well as the lower wall 73 of the collection duct. A separate profiled sheet 74 forms the upper wall 75 of the collection duct and is provided with flanges 76 and 77 for joining together the longitudinal edges of the lower and upper walls 73 and 75 by means of adhesive tape. Figures 8 and 9 show plan views of the sheets 70 and 74, and in addition Figure 9 shows holes 78 drilled in the upper surface 75 for the passage of particles into the collection duct.

CLAIMS

1. A particle collection system comprising trough means for receiving particles therein, collection duct means associated with the trough means for receiving particles from the trough means, air flow induction means for inducing a relatively large volume carrier air flow at relatively low pressure in the collection duct means in response to a relatively small volume control air flow at relatively high pressure in order to draw particles along the collection duct means in the carrier air flow, and air conduit means into which the particles are drawn in the carrier air flow from the collection duct means and along which the particles are conducted towards a particle collection zone.

2. A system according to claim 1, wherein the trough means comprises a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles towards the bottoms of the troughs, and the collection duct means comprises a series of collection ducts each of which is provided at the bottom of a respective one of the troughs.

3. A system according to claim 2, wherein the troughs include transverse dividers spaced at intervals along their lengths.

4. A system according to claim 1, 2 or 3, wherein the air flow induction means comprises a respective air flow inducer coupled to each collection duct so as to draw particles along the collection duct towards the air conduit means in a carrier

air flow induced by a control air flow applied to the air flow inducer.

5. A system according to claim 4, wherein an air controller is coupled to the air flow induction means so as to apply pulsed control air flows to the air flow inducers in a predetermined sequence so as to induce pulsed carrier air flows in the collection ducts.

6. A system according to claim 5, wherein the air flow induction means comprises a plurality of pairs of air flow inducers, and the air controller is arranged to apply a respective pulsed control air flow to each pair of air flow inducers separately from each of the other pairs of air flow inducers and to apply such control air flows to the pairs of air flow inducers consecutively.

7. A system according to any preceding claim, wherein the air conduit means comprises a common air conduit along which a continuous flow of air is conducted and into which the particles are drawn from the collection duct means by a series of carrier air flows.

8. A system according to any preceding claim, wherein the air conduit means is coupled to cyclone means for separating the particles from the continuous flow of air and for supplying the separated particles to the particle collection zone.

9. A system according to any preceding claim, wherein the air conduit means is coupled to a fan for drawing said continuous flow of air therethrough and may be

provided with a damper for controlling the input of air drawn into the air conduit means by the fan.

10. A particle cleaning system comprising cyclone means for receiving an air flow containing particles and entrained material and incorporating outlet means through which particles and entrained material separated from the air flow by the cyclone means pass towards a particle collector, extraction means defining a gap through which the separated particles and entrained material are conducted as they pass through the outlet means and incorporating an extraction duct opening into the gap, and air flow induction means for inducing a relatively large volume carrier air flow at a relatively low pressure in the extraction duct in response to a relatively small volume control air flow at a relatively high pressure in order to draw entrained material away from the particles conducted through the gap and carry the entrained material in the induced carrier air flow along the extraction duct towards an entrained material extraction zone.

11. A particle collection system comprising a floor incorporating a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles which land on the floor towards the bottoms of the troughs, and a series of collection ducts each of which is provided at the bottom of a respective one of the troughs and has a lower wall which is integrally formed with at least one of the side walls of the trough and an upper wall which is joined to the lower wall along its longitudinal edges, holes being provided at intervals along the length of the upper wall for passage of particles into the duct.

12. A particle collection system substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report) - 17 -

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Relevant Technical Fields

(i) UK Cl (Ed.M) BIT (TPFB, TPFK, TPPA)

(ii) Int Cl (Ed.5) B04C 5/00; B04C 9/00; B0D 50/00; B0D 51/06

Search Examiner
A J RUDGE

Date of completion of Search
17 JANUARY 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI, CLAIMS, EDOC, WPIL

Documents considered relevant following a search in respect of Claims :-
1-10

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

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